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**2003 PROGRESS REPORT  
ON  
THE PHASE-DOWN OF  
RICE STRAW BURNING  
IN THE SACRAMENTO VALLEY AIR BASIN**

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**CALIFORNIA AIR RESOURCES BOARD  
CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE  
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## STATE OF CALIFORNIA

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## **Progress Report on the Phase-down of Rice Straw Burning in the Sacramento Valley Air Basin**

### **Background and Public Health Information**

Over 500,000 acres of rice are grown each year in the Sacramento Valley. Before the Connelly-Areias-Chandler Rice Straw Burning Reduction Act of 1991 (AB 1378, Ch. 787, 1991) (Act), most of these acres were burned to control rice disease and prepare the fields for the following year's crop. Burning during the fall is most effective for disease control. Therefore, growers try to burn as much as possible during the fall. Unfortunately, relative to the spring, the fall can be a poor time to burn because of poor air quality due to stagnant meteorological conditions. Fall meteorological conditions frequently result in smoke lingering for days.

Smoke exposure has been associated with adverse health effects particularly among those with respiratory and cardiovascular illness.<sup>1</sup> Additionally, research conducted at the Lung Biology Center at the University of California, San Francisco, "indicates that [rice straw smoke] is capable of inducing airway inflammation in healthy individuals, and in individuals with asthma, or allergic rhinitis."<sup>2</sup>

### **Phase-down of Rice Straw Burning**

In order to reduce the public health impacts of rice straw burning, the Legislature voted in 1991 to phase-down the burning of rice straw in the Sacramento Valley. This phase-down occurred over a period of nearly ten years, with progressively fewer acres of rice fields eligible to be burned each year. 2001 marked the final year of the phase-down. Starting in 2001, the Act sets the limit on the rice acreage which can be burned at 25% of an individual grower's planted acreage, not to exceed 125,000 acres basinwide. In addition to these basinwide acreage caps, individual fields can only be burned for disease control.

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1 Liu, D.; Tager, I.; Balmes, J.; Harrison, R. 1992. The Effect of Smoke Inhalation on Lung Function and Airway Responsiveness in Wildland Fire Fighters. *Am. Rev. Respir. Dis.* 146:1469-1473.

2 Solomon, C.; Jenkins, B.; Balmes, J. 2003. The Effect of Smoke from Burning Vegetative Residues on Airway Inflammation and Pulmonary Function in Healthy, Asthmatic and Allergic Individuals. ARB Contract Number 97-322.

The phase-down has proceeded as specified in the Act, with growers achieving greater acreage reductions than mandated basinwide. Table 1 shows that the total rice acreage burned annually has declined from 303,000 acres in 1992, the first year of the phase-down, to slightly fewer than 72,000 acres in 2002.

The frequency of complaints from the public about smoke from agricultural burning is sometimes used as an indicator of the extent to which the public is subjected to impacts of smoke. While complaints may not be a true representation of smoke impacts, they can provide useful information about the smoke management program. The ARB and the air pollution control districts (districts) track the number of smoke complaints received from the public during the fall intensive burn period; Table 1 includes these complaints.

**Table 1**  
**Rice Straw Burning Phase-down**  
**Maximum Allowable Acreage and Actual Acres Burned**  
**Sacramento Valley**

Burn Year (Sept 1 – Aug 31)		Rice Acres Planted	Rice Acres Burned	Phase-down Act: % Acres Allowed to be Burned (acres)	% Acres Actually Burned	Smoke Related Complaints*
	1992	401,807	303,103	90%	75%	59
	1993	450,253	305,636	80%	68%	101
	1994	514,045	293,210	70%	57%	335
	1995	500,705	268,216	60%	54%	133
	1996	514,720	211,322	50%	41%	141
	1997	517,233	133,640	38%	26%	80
Pause Years	1998	490,625	140,627	200,000 acres	29%	42
	1999	535,949	137,930	200,000 acres	26%	15
	2000	521,000	143,030	200,000 acres	27%	38
	2001	501,648	76,797	24.9% (125,000 acres)	15%	22
	2002	542,225	71,890	23% (125,000 acres)	13%	13

Data from ARB Meteorology Section and the Sacramento Valley Basinwide Air Pollution Control Council.

\* Smoke related complaints are included for the fall burn season only.

### **Sacramento Valley Smoke Management Program**

While the Act limits the total acreage of rice eligible to be burned, it is critical to manage when, where, and how all agricultural burning, not just rice straw burning, is done to minimize the public's exposure to smoke. These activities are addressed with the smoke management program administered by the ARB and the districts within the Sacramento Valley. The heart of this program, the Sacramento Valley Air Basin Smoke Management Program (Burn Program), is prepared according to title 17, section 80155, of the California Code of Regulations.

One key component of the Burn Program is the Conditional Rice Straw Burn Permit Program (CRSBPP). Through this program, the Sacramento Valley Basinwide Air Pollution Control Council (BCC) ensures that the disease requirements and the basinwide acreage cap limitations in the Act are met. The BCC is comprised of one elected official from each of the districts in the Sacramento Valley Air Basin.

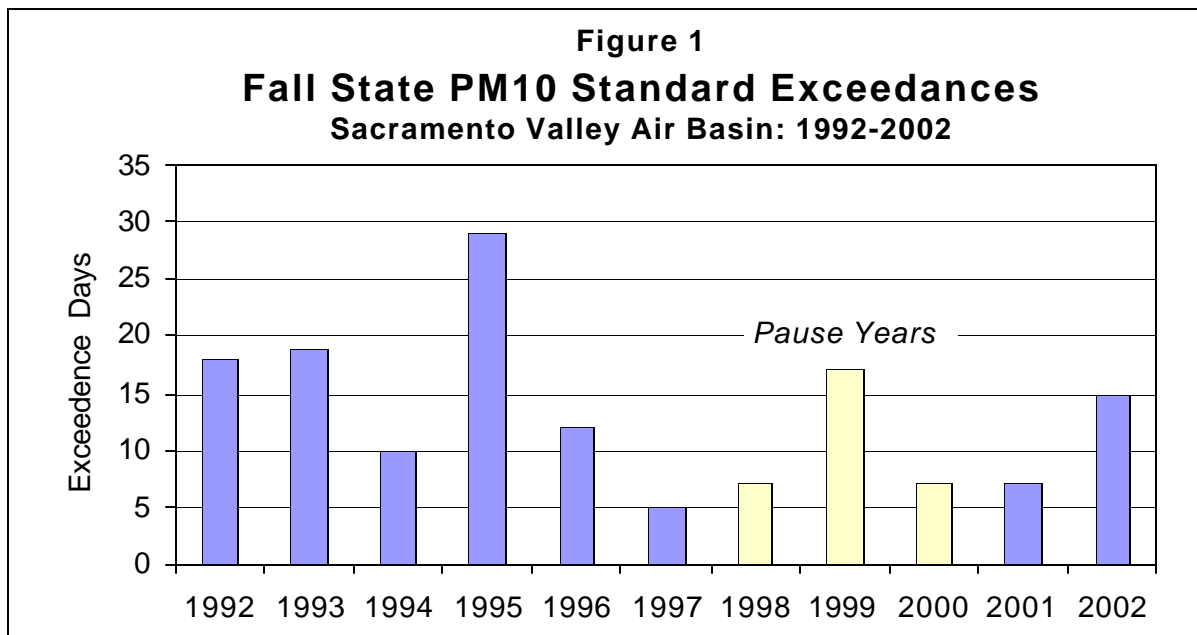
Beginning in the 2001 burn year, the CRSBPP sets the conditions under which a rice grower can qualify to burn one of his/her fields. In the first two years of the program, growers collected samples throughout their fields to certify the fields for burning under a Conditional Rice Straw Burn Permit. This sample collection took place in the window of time between when the disease manifested itself and the harvest took place. This time period is about one month, during which the growers inspect their fields, request a certification and await any needed county inspection verification, all the while focusing on the primary aspects of growing rice. Individual field inspections effectively verified disease presence, but the process was time consuming and costly for the growers, the local agricultural commissioners, and the districts.

ARB staff worked with rice growers, county agricultural commissioners, the BCC, and the public to streamline the disease certification process. Beginning with the 2003 burn year, county agricultural commissioners can use random sampling and statistical analysis of rice fields throughout their jurisdiction to verify disease presence. If the statistical analysis of the samples verifies the presence of disease, the agricultural commissioners can certify all rice fields within the county. If the statistical analysis fails to provide the basis for a countywide certification, individual growers retain the ability to certify individual fields.

Another key component of the Burn Program is the daily allocation of acreage available to be burned. The burning allowed each day depends on current and anticipated meteorological and air quality conditions. The Burn Program allows more acres to be burned on days with good air flow, restricts burning on days with limited ability to disperse smoke, and does not allow agricultural burning on days with poor meteorological and air quality conditions.

The smoke management program is more restrictive during the fall than in the spring. However, fall burning is more effective for controlling rice diseases than is spring burning. Consequently, growers try to burn as much acreage as possible at that time, subject to the provisions of the Burn Program and the phase-down. Historically, hundreds of thousands of acres of agricultural residue were burned during the fall. Over the last decade, the combination of the phase-down and the Burn Program have reduced the acres burned during the fall months. While growing practices and other factors favor fall burning, shifting as much burning as possible to the spring lessens the air quality impacts of burning. Figure 1 shows the number of days on which the State PM<sub>10</sub> standard was exceeded in the Sacramento Valley Air Basin during the fall burn season. Natural sources of emissions also contribute to PM<sub>10</sub> standard exceedances, and are not as easily controlled. For example, the fall

months of 1999 and 2002 saw a large number of wildfires in the western United States, which affected air quality in California.



### Alternatives to Burning

Effective alternatives to rice straw burning are critical to the long-term success of the phase-down. However, despite State subsidized grant and tax credit programs, off-field uses of rice straw have not materialized as quickly as hoped. Soil incorporation is the preferred alternative straw management practice for rice acreage not burned. Off-field uses of rice straw continue to be slow to develop; current information continues to support that 3-5% (18,000 tons) of the rice straw grown in California is used off-field. Most of the straw used off-field is used in a non-processed form (i.e. cattle feed and erosion control). However, as discussed in the following sections, potential uses of rice straw continue to be explored. Unless off-field uses of rice straw increase more substantially, incorporation will remain the primary alternative to burning. A summary of State programs to promote off-field uses of rice straw is provided below.

### Rice Straw Expo 2002

On July 19, 2002, the ARB and the University of California, Davis, organized the Rice Straw Expo 2002 (Expo) to showcase products made with rice straw. The Expo was co-sponsored by the California Rice Commission, several State and local government agencies, rice straw product manufacturers and service providers, and the environmental community. The Expo provided an opportunity for rice straw product manufacturers and service providers to network with consumers, including those in the public and private sectors. The Expo had an audience of more than 200 people and 16 exhibitors.

The products and services on display included manufactured wallboards, compost, worm castings, erosion control wattles, and straw bale building information. Information was on hand from each of the product manufacturers, as well as several government agencies that currently use or promote rice straw in California. Additionally, the California Rice Commission used the Expo to launch their RiceStrawMarkets.org website. Rice StrawMarkets.org is designed to be the central point for information about rice straw usage on the World Wide Web.

The Expo included several discussion panels, where experts presented information on the latest developments in rice straw utilization. The topics included developments in chemical and energy production from rice straw, trends in agricultural use of rice straw, new resins for wall board construction, and updates on uses of rice straw bales as an energy and resource efficient building material. In their current states, most of these alternatives use minimal amounts of rice straw. However, several hold the potential for increased usage, with continued community, regulatory, and funding support.

### **Grant and Tax Credit Programs**

In an effort to promote alternatives to rice straw burning, the Legislature has funded several programs. These programs are:

- ARB's Rice Straw Demonstration Project Grant Fund
- CDFA's Rice Straw Utilization Tax Credit Program
- CDFA's Biomass Utilization Grant Fund

#### ***The Rice Straw Demonstration Project Grant Fund***

Since its establishment in 1997, the ARB has awarded \$5 million in funds to 10 recipients for demonstration and commercialization projects through the Rice Straw Demonstration Project Grant Fund. A summary of these projects can be found in the 2001 report to the Legislature entitled "Progress Report on the Phase Down and the 1998-2001 Pause in the Phase Down of Rice Straw Burning in the Sacramento Valley Air Basin." No funds have been available through this program since the 1999-2000 fiscal year.

#### ***Rice Straw Utilization Tax Credit Program***

The Rice Straw Utilization Tax Credit Program was established by SB 38 (Lockyer, Ch. 954, 1996) as Section 17052.10 of the State Revenue and Taxation Code. The law provides that for each taxable year, between 1997 and 2008, the end users of rice straw can qualify for a \$15 per ton state tax credit up to a \$400,000 program cap. The CDFA has administered the program since 1997 and has issued tax credits for over 90,000 tons of rice straw. There has been steady growth in both the number of program applicants and amount of straw utilized from 6,000 tons in 1997 to 18,000 tons in 2002. The growth has been primarily with small businesses



utilizing rice straw for animal feeding and erosion control products. While the program has helped stimulate growth of the fledgling rice straw industry, 18,000 tons still only represents 3-5% of harvestable straw in a given year. More detailed information on this program is available on the Rice Straw Tax Credit website [http://www.cdfa.ca.gov/exec/aep/rstc\\_program/AES\\_rstc.htm](http://www.cdfa.ca.gov/exec/aep/rstc_program/AES_rstc.htm).

### ***Agricultural Biomass Utilization Account/Rice Straw Utilization Grant Program***

The Agricultural Biomass Utilization Account was established by AB 2514 (Thomson, Ch. 1017, 2000) and allocated \$2 million to facilitate development of off-field uses of rice straw as a means to avoid the financial or air-quality costs of on-field disposal. With the account, the CDFA developed the Rice Straw Utilization Grant Program that awarded eight grants in 2001 to businesses that demonstrated the ability to expand use of rice straw in the near term over and above existing quantities of use. The incentive grants were based on a rate of \$20 per ton utilized on either a per-ton or on a per-project basis with no single grant exceeding \$300,000. The projects include two energy related rice straw uses, three projects to further develop the use of rice straw as a feed ration for range or dairy cattle, one project to expand the market for a rice straw erosion control product, and two projects to further develop the use of rice straw as a building material. More detailed information on this program is available on the Rice Straw Utilization Grant website [http://www.cdfa.ca.gov/exec/aep/rs\\_grant%20program/AES\\_rs\\_grant.htm](http://www.cdfa.ca.gov/exec/aep/rs_grant%20program/AES_rs_grant.htm).

### **Environmental Assessment**

From an air quality standpoint, the phase-down has had a positive public health and environmental impact due to reduced air emissions. Non-air quality impacts associated with the Phase-down are less certain. On the positive side, winter flooding has been viewed as a benefit to migratory birds passing through California. Conversely, there has been concern that increased use of pesticides to control rice disease may result in increased impacts on water quality and reduced habitat quality for wildlife. However, the information available to verify these non-air quality impacts, adverse or otherwise, is not readily available. The ARB and CDFA will continue to monitor the research into these impacts.

### **Economic Assessment**

Varying economic impacts on individual growers have resulted from the phase-down. These depend primarily on the farmer's ability to incorporate straw. The cost of incorporation into the soil, the primary alternative to burning, has added to the costs of growing rice. The estimated average post-harvest cost of rice straw management is estimated at about \$32 per acre<sup>3</sup>. This cost includes \$3 per acre for burning on 15% of the total acreage planted, and \$29 to chop, disc and flood the remaining acres. However, these costs can vary from grower to grower, with costs

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<sup>3</sup> Williams, J.; Mutters, R.; Klonsky, K.; De Moura, R.; 2001 Sample Cost to Produce Rice, Sacramento Valley, Rice Only Rotation; University of California Extension; Report Number RI-SV-01.

ranging between \$29 to \$47 per acre depending on the residue management technique used.<sup>4</sup> Rice straw harvesting and baling can cost \$50 per acre or more for a yield of 2 tons per acre with additional transport and storage costs of \$7 - \$30 per ton. Value-added markets for rice straw must be able to cover these costs to have long term viability. Until larger markets for rice straw become viable, it is expected that the rice growers will continue to absorb the post-harvest straw incorporation costs into their operating costs.

## **CONCLUSIONS**

The phase-down requirements are being met and the Conditional Rice Straw Burn Permit Program is operating successfully. However, alternative uses for rice straw have not developed as quickly as hoped. Although soil incorporation is more costly than burning, it will likely continue to be the most common post-harvest straw management practice until a sustainable market for rice straw based products develops. As such, the Smoke Management Program will continue to be an essential component of the overall program to minimize the public's exposure to rice straw smoke. Tax-credit and grant programs remain effective methods to partially defray the handling costs and promote the development of off-field uses of rice straw.

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<sup>4</sup> Williams, J.; Estimated Cost of Rice Straw Management; University of California Cooperative Extension; June 2001.